

**Quasi-spherical fuel compression and fast ignition in a heavy-ion-driven X-target with one-sided illumination**

by

Enrique Henestroza, B.Grant Logan, L.John Perkins

from

Lawrence Berkeley National Laboratory (on behalf of U.S. HIFS-VNL)

1 Cyclotron Road, Berkeley, CA 94720

Accelerator Fusion Research Division

University of California

Berkeley, California 94720

and

Lawrence Livermore National Laboratory

March 2011

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor The Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or The Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or The Regents of the University of California.

# Quasi-spherical fuel compression and fast ignition in a heavy-ion-driven X-target with one-sided illumination

Enrique Henestroza,<sup>1</sup> B.Grant Logan,<sup>1</sup> and L.John Perkins<sup>2</sup>

<sup>1</sup>*Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA*

<sup>2</sup>*Lawrence Livermore National Laboratory, Livermore, California 94550, USA*

## ABSTRACT

The HYDRA radiation-hydrodynamics code [M. M. Marinak *et al*, Phys. Plasmas **8**, 2275 (2001)] is used to explore one-sided axial target illumination with annular and solid-profile uranium ion beams at 60 GeV to compress and ignite deuterium-tritium (DT) fuel filling the volume of metal cases with cross sections in the shape of an “X” (X-target). Quasi-three-dimensional, spherical fuel compression of the fuel towards the X-vertex on axis is obtained by controlling the geometry of the case, the timing, power and radii of three annuli of ion beams for compression, and the hydro-effects of those beams heating the case as well as the fuel. Scaling projections suggest that this target may be capable of assembling large fuel masses resulting in high fusion yields at modest drive energies. Initial two-dimensional calculations have achieved fuel compression ratios of up to 150X solid density, with an areal density  $\rho R$  of about 1 g/cm<sup>2</sup>. At these currently modest fuel densities, fast ignition pulses of 3 MJ, 60 GeV, 50 ps, and radius 300  $\mu$ m are injected through a hole in the X-case on axis to further heat the fuel to propagating burn conditions. The resulting burn waves are observed to propagate throughout the tamped fuel mass, with fusion yields of about 300 MJ. Tamping is found to be important, but radiation drive to be unimportant, to the fuel compression. Rayleigh-Taylor instability mix is found to have minor impact on ignition and subsequent fuel burn up.